AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions or listings of claims for this application.

Listing of Claims:

1. (Previously presented) A pixel cell comprising:

a substrate;

a gate of a transistor formed at least partially below a surface of the substrate, the gate having a bottom surface below the surface of the substrate;

a channel region of the transistor located below the bottom surface of the gate; and

a photo-conversion device formed adjacent to the gate, the photo-conversion device comprising a doped surface layer of a first conductivity type, and a doped region of a second conductivity type underlying the doped surface layer, wherein the doped surface layer is at a level approximately between a level of a top surface of the gate and a level of the bottom surface of the gate, and wherein the second conductivity type layer is at a level below the level of the bottom surface of the gate.

2. (Original) The pixel cell of claim 1, wherein the first and second conductivity types are p and n respectively.

3. (Original) The pixel cell of claim 1, wherein the photo-conversion device is a pinned photodiode.

4. (Original) The pixel cell of claim 1, wherein the gate is the gate of a transfer transistor.

5. (Original) The pixel cell of claim 1, wherein the gate is the gate of a reset transistor.

6. (Original) The pixel cell of claim 1, wherein the gate is the gate of a charge coupled device.

7. (Original) The pixel cell of claim 1, further comprising a sensing node adjacent to the gate and on an opposite side of the gate from the photo-conversion device.

8. (Original) The pixel cell of claim 7, wherein the sensing node is a floating diffusion region.

9. (Original) The pixel cell of claim 1, wherein the doped surface layer has a thickness within the range of approximately 200 to approximately 2000 Å.

10. (Original) The pixel cell of claim 1, wherein the implant dose of a dopant for the doped surface layer is within the range of approximately 1×10^{12} to approximately 3×10^{14} atoms per cm^2.

11. (Canceled).

12. (Original) The pixel cell of claim 1, further comprising a trench in the substrate, wherein the gate is at least partially in the trench.

13. (Original) The pixel cell of claim 12, wherein the trench has a depth within the range of approximately 500 to approximately 2500 Å.

14. (Original) The pixel cell of claim 1, wherein the gate comprises:

a conductive layer; and

insulating material, wherein the insulating material is on at least two lateral sides of the conductive layer.

15. (Original) The pixel cell of claim 14, wherein the insulating material on the two lateral sides of the gate has a thickness within the range of approximately 20 to approximately 100 Å thick.

16. (Original) The pixel cell of claim 14, wherein the doped surface layer is in contact with the insulating material.

17. (Original) The pixel cell of claim 1, wherein operation of the gate affects the doped surface layer at least partially through a sidewall of the gate.

18. (Original) The pixel cell of claim 1, wherein the gate is part of a CMOS imager.

19. (Original) The pixel cell of claim 1, wherein the gate is part of a charge coupled device imager.

20. (Currently Amended) A pixel cell comprising:

a substrate;

a trench in the substrate;

a gate of a transistor at least partially in the trench;

a channel region of the transistor formed below the trench;

a photo-conversion device formed adjacent to the trench, the photo-conversion device comprising a doped surface layer of a first conductivity type below the surface of the substrate, and a doped region of a second conductivity type underlying the doped surface layer of a first conductivity type, wherein the doped surface layer is at least partially above a level of a bottom surface of the trench, wherein the doped surface layer is at a level approximately between a level of a top surface of the gate and a level of the bottom surface of the gate, and wherein the second conductivity type layer is at a level below the level of the bottom surface of the gate.

21. (Original) The pixel cell of claim 20, wherein the trench has a depth within the range of approximately 500 to approximately 2500 Å.

22. (Original) The pixel cell of claim 20, wherein the gate comprises:

a conductive layer; and

insulating material, wherein the insulating material is on at least two lateral sides of the conductive layer.

23. (Original) The pixel cell of claim 22, wherein the insulating material on the two lateral sides of the gate has a thickness within the range of approximately 20 to approximately 100 Å thick.

24. (Previously presented) An imager system, comprising:

a processor; and

an imager coupled to the processor, the imager comprising:

a substrate;

a pixel formed over the substrate, the pixel comprising:

a gate of a transistor formed at least partially below a surface of the substrate, the gate having a bottom surface below the surface of the substrate;

a channel region of the transistor located below the bottom surface of the gate; and

a photo-conversion device formed adjacent to the gate, the photo-conversion device comprising a doped surface layer of a first conductivity type, and a doped region of a second conductivity type underlying the doped surface layer, wherein the doped surface layer is at least partially above a level of a bottom surface of the gate wherein the doped surface layer is at a level approximately between a level of a top surface of the gate and a level of the bottom surface of the gate, and wherein the second conductivity type layer is at a level below the level of the bottom surface of the gate.

25. (Original) The system of claim 24, wherein the imager is a CMOS imager.

26. (Original) The system of claim 24, wherein the imager is a charge coupled device imager.

27. (Original) The system of claim 24, wherein the first and second conductivity types are p and n respectively.

28. (Original) The system of claim 24, wherein the photo-conversion device is a pinned photodiode.

29. (Original) The system of claim 24, wherein the gate is the gate of a transfer transistor.

30. (Original) The system of claim 24, wherein the gate is a transfer gate of a charge coupled device.

31. (Original) The system of claim 24, further comprising a sensing node adjacent to the gate and on an opposite side of the gate from the photo-conversion device.

32. (Original) The system of claim 31, wherein the sensing node is a floating diffusion region.

33. (Original) The system of claim 24, wherein the doped surface layer has a thickness within the range of approximately 200 to approximately 2000 Å.

34. (Canceled).

35. (Original) The system of claim 24, further comprising a trench formed in the substrate, wherein the gate is at least partially in the trench.

36. (Original) The system of claim 35, wherein the trench has a depth within the range of approximately 500 to approximately 2500 Å.

37. (Original) The system of claim 24, wherein operation of the gate affects the doped surface layer at least partially through a sidewall of the gate.

Claims 38-58 (Canceled).

59. (Currently Amended) A pixel cell comprising:

a substrate;

a trench in the substrate;

a gate of a transistor formed in the trench and contained within the lateral boundaries of the trench, the gate having a bottom surface below the surface of the substrate;

a channel region of the transistor located below the bottom surface of the gate; and

a photo-conversion device formed adjacent to the gate, the photo-conversion device comprising a doped surface layer of a first conductivity type, and a doped region of a second conductivity type underlying the doped surface layer, wherein the doped surface layer is at least partially above a level of a bottom surface of the gate and wherein the second conductivity type layer is at a level below the level of the bottom surface of the gate.

60. (Previously presented) The pixel cell of claim 59, wherein the photo-conversion device is a pinned photodiode.

61. (Previously presented) The pixel cell of claim 59, wherein the gate is the gate of a transfer transistor.

62. (Previously presented) The pixel cell of claim 59, wherein the gate is the gate of a reset transistor.

63. (Previously presented) The pixel cell of claim 59, further comprising a sensing node adjacent to the gate and on an opposite side of the gate from the photo-conversion device.

64. (Previously presented) The pixel cell of claim 59, wherein the doped surface layer is at a level approximately between a level of a top surface of the gate and a level of the bottom surface of the gate.

65. (Previously presented) The pixel cell of claim 59, wherein the trench has a depth within the range of approximately 500 to approximately 2500 Å.